Alaska Fisheries Data Series 96-4
June 1996

RESIDENT FISHERY RESOURCES OF THE SWANSON RIVER WATERSHED, KENAI NATIONAL WILDLIFE REFUGE, ALASKA (1988-1989)

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Abstract.— As part of a two-year (1988-1989) investigation of the fishery resources in the Swanson River watershed, data were collected on resident fish populations, with an emphasis on rainbow trout *Oncorhynchus mykiss*. The relative abundance of resident fish species in the mainstem river and eleven headwater lakes was examined by a combination of minnow trapping, beach seining, gill netting and electrofishing. The timing and duration of adult and juvenile rainbow trout migration between the Swanson River and Sucker Creek drainage were examined by monitoring the daily number of upstream and downstream migrants. Spawning distribution of rainbow trout in the Swanson River drainage was examined by conducting ground surveys of the mainstem river and outlet streams of lakes known to support rainbow trout. Data were recorded on the lengths, weights, sex and age of rainbow trout and used to construct length frequency distributions, develop length-weight relationships and examine relative condition.

Resident species collected in the Swanson River mainstem included: rainbow trout, threespine stickleback *Gasterosteus aculeatus*, ninespine stickleback *Pungitius pungitius*, slimy sculpin *Cottus cognatus*, Dolly Varden *Salvelinus malma*, and longnose sucker *Catostomus catostomus*. Slimy sculpin and threespine stickleback were generally the most frequently collected species. Rainbow trout were more abundant in the upper reaches than the lower reaches of the river.

Resident fish species collected in headwater lakes included rainbow trout, longnose sucker, slimy sculpin, threespine stickleback, Arctic char *S. alpinus*, and coastrange sculpin *C. aleuticus*. Rainbow trout and longnose sucker were the most frequently collected species in gillnets. Gruska, Nest, Hungry and Wilderness lakes had the highest abundance of rainbow trout. No fish were collected in Jigsaw Lake.

Rainbow trout were observed migrating downstream from Sucker Creek into the Swanson River from late-April to late-May. Peak downstream numbers occurred during mid-May. Upstream migrating rainbow trout were observed from late-April to late-October with the peak occurring in late-May.

Rainbow trout were observed spawning in one area in the upper Swanson River watershed and throughout the lower reaches. Sucker Creek was the only tributary where large numbers of rainbow trout were observed spawning.

Rainbow trout captured in the mainstem river were primarily age 1 and 2 with fork lengths ranging between 50 and 291 mm. Rainbow trout captured in headwater lakes were primarily age 3 and older with fork lengths ranging between 82 and 500 mm.

Introduction

The Swanson River is the second most popular watershed for consumptive and non-consumptive recreational activities on the Kenai National Wildlife Refuge (Refuge)(Figure 1). Opportunities for fishing, hunting, canoeing and camping in a wilderness setting cause the Swanson River watershed to receive extensive public use. These fishery resources also support wildlife such as brown and black bears *Ursus spp.*, mergansers *Mergus spp.* and bald eagles *Haliatetus leucocephalus.*

The impact of increasing sport fishing pressure and harvest in the Swanson River watershed was identified as a major concern (U.S. Fish and Wildlife Service 1985). Excluding 1984, the annual use of the Swan Lake and Swanson River Canoe Trails averaged about 25,600 visitor days from 1981 to 1989 (U.S. Fish and Wildlife Service 1981-1990). Outfitters maintain semi-permanent tent camps on four remote lakes that are not on the canoe trails and offer fly-in fishing expeditions. From 1977 to 1987, the annual angler use of the river and canoe route lakes averaged 7,817 angler days (Nelson 1995). Since the study, angler days for the system increased to an average of 10,627 (Mills 1984-94, Howe et al. 1995). The average annual harvest, of rainbow trout *Oncorhynchus mykiss* from the Swanson River, Swanson River lakes and Swan Lake canoe trails, averages around 5,223 fish (Nelson 1995).

A major feature of the Swanson River watershed is the Swanson River Oil Field (Figure 2). The Swanson River Oil Field, found in 1957, was the first substantial oil discovery in Alaska (U.S. Fish and Wildlife Service 1985). That discovery developed into a major oil and natural gas field. Nearly 100 wells have been drilled on this 3,200-hectare field and numerous support facilities have been built, including over 53 km of access roads. Development of oil and gas resources in the Swanson River drainage could, without adequate safeguards, impact refuge habitats and fish populations.

Available fishery resource information on resident fish is too limited for adequate evaluation of the ability of sport fish populations to sustain current levels of harvest. The U.S. Fish and Wildlife Service (Service) identified the need for additional information on the fishery resources of the Swanson River as one of the highest priorities for fisheries work on the Refuge. The Service funded a two-year investigation of the Swanson River watershed fishery resources during 1988 and 1989. This report presents data on resident fish populations, with emphasis on rainbow trout. Objectives for this part of the project were to:

1. Determine the relative abundance of fish species in the mainstem of Swanson River and selected headwater lakes;
2. Examine the migration of adult and juvenile rainbow trout between the Swanson River and various headwater lakes;
3. Evaluate the spawning distribution of rainbow trout; and,
4. Characterize the weight-length relationships of rainbow trout in the Swanson River.

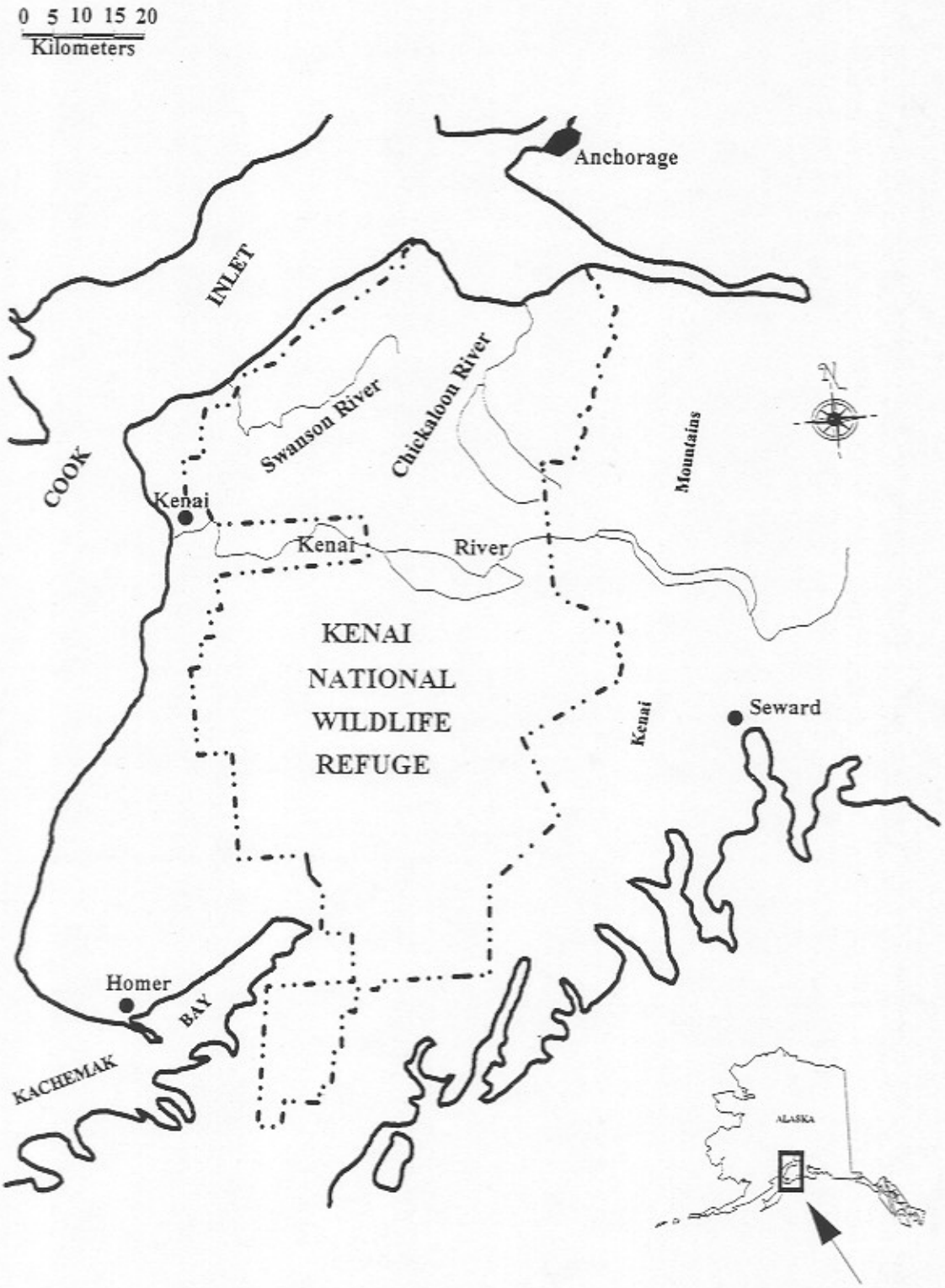

FIGURE 1.—Location of Swanson River drainage on the Kenai National Wildlife Refuge, Alaska.

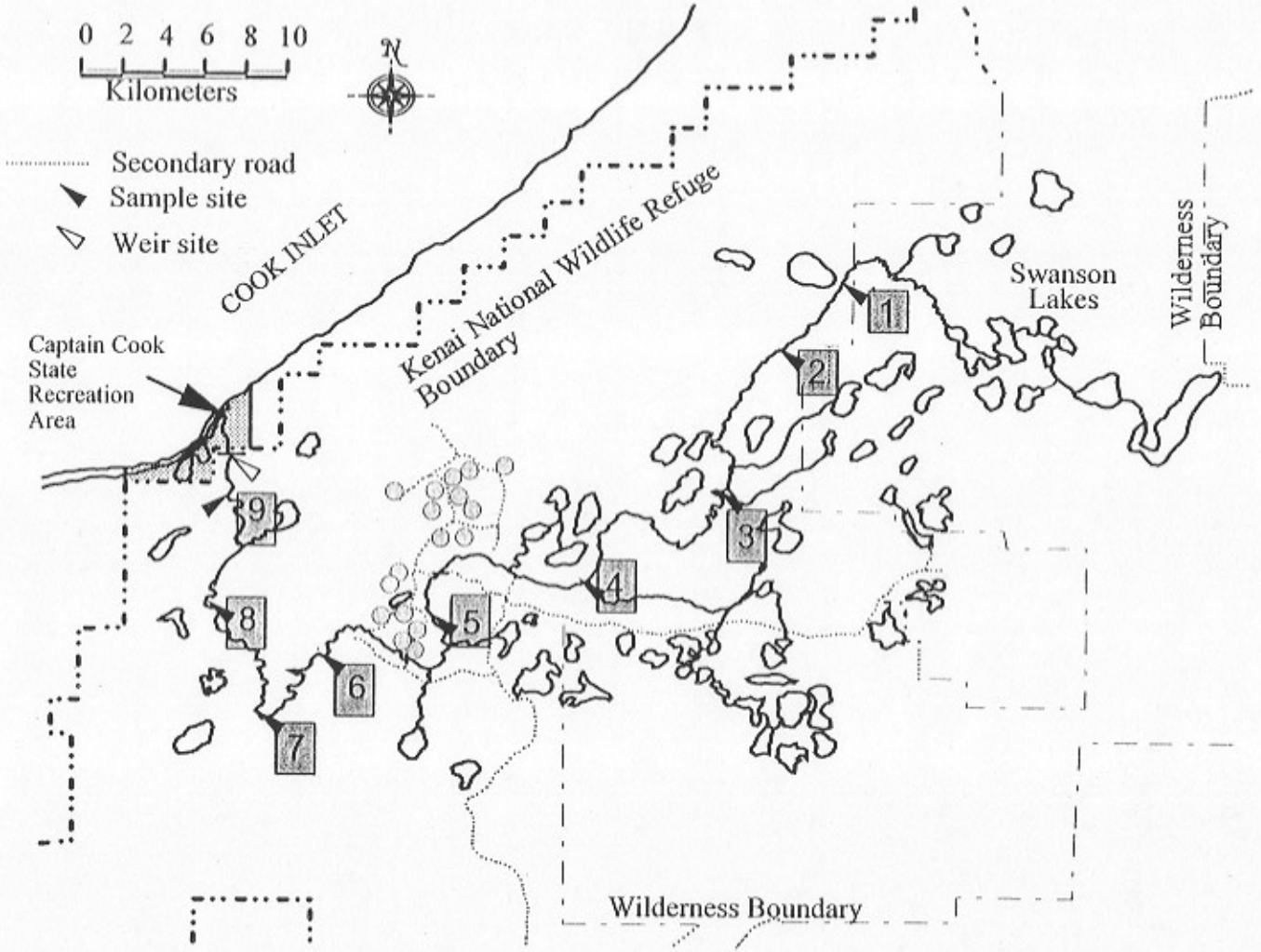

FIGURE 2.–Map of major features and mainstem sample sites in the Swanson River drainage, Kenai National Wildlife Refuge, Alaska.

Study Area

The Swanson River, located in the northwestern portion of the Kenai Peninsula, originates in the Swanson Lakes area and encompasses about 717 km^2 (Figure 1). Approximately 99% of this watershed is on the Refuge. Its headwaters are in the Lowland Unit of the Kenai Wilderness Area. The lower 1.9 km of the Swanson River flows through Captain Cook State Recreation Area and into Cook Inlet.

The Lowland Unit is a region of flat to gently rolling terrain occupying an ancient glacial lake bed. The area is characterized by a widely interconnected network of mostly abandoned muskeg-filled drainages and a series of muskeg covered terrace levels (Karlstrom 1964).

Elevations in the watershed range from 15 to 90 m. As a result, the Swanson River is shallow and meanders extensively throughout most of its course. The mainstem is about 77 km in length and has an average gradient of 0.8 m/km. Stream gradients range from 0.3 m/km in the upper reaches to 1.4 m/km in the lower 6 km of the river. The average, maximum and minimum discharges measured near river kilometer (rkm) 2, from 12 June, 1987 to 22 June, 1989, were 6.0, 45.0 and 1.5 m^3/s, respectively (Inghram and Ireland 1990).

The Swanson River watershed contains more lakes than any other watershed on the Refuge with more than 1,000 lakes ranging from 3-350 hectares in size. More than 50 of these lakes in the headwaters were set aside to form two National Recreation Trails, the Swanson River and Swan Lake Canoe Routes.

These two routes provide the primary access for anglers into headwater lakes and upper portions of the Swanson and Moose rivers. Other access is provided by Swanson River Road, a secondary road about 34 km east of Kenai near Sterling and the Kenai Spur Highway, which ends at Captain Cook State Recreation Area (Figure 2).

Methods

Relative Abundance

Swanson River.—Preliminary sampling was conducted at three locations (1, 2 and 4) in the Swanson River (Figure 2) in 1988. Fish were collected with minnow traps, a 12 x 1.5 m beach seine and a Coffelt Model BP-1C electrofishing unit (pulsed DC). All fish collected were identified and counted. Catch per unit of effort (CPUE) was used as an index of relative abundance for comparison among all 9 sampling locations in 1989.

Headwater lakes.—Resident fish populations were examined in eleven headwater lakes (Figure 3), after rainbow trout spawning. Lake sampling occurred during June-September. Each lake was sampled once during this two-year survey. Fish were collected with sinking and floating gill nets set out in pairs running perpendicular to the shoreline. Gill nets were 30 m long, 2.4 m deep and had five 6 m panels of 25, 51, 64, 76 and 102 mm stretched mesh. Gill nets were fished overnight, usually 12 to 18 hours. One to three seine hauls were made in each lake depending on the availability of suitable shoreline sampling locations. In 1988, one fine mesh gill net was set in each lake to sample juvenile salmonids and smaller sized fish species. The

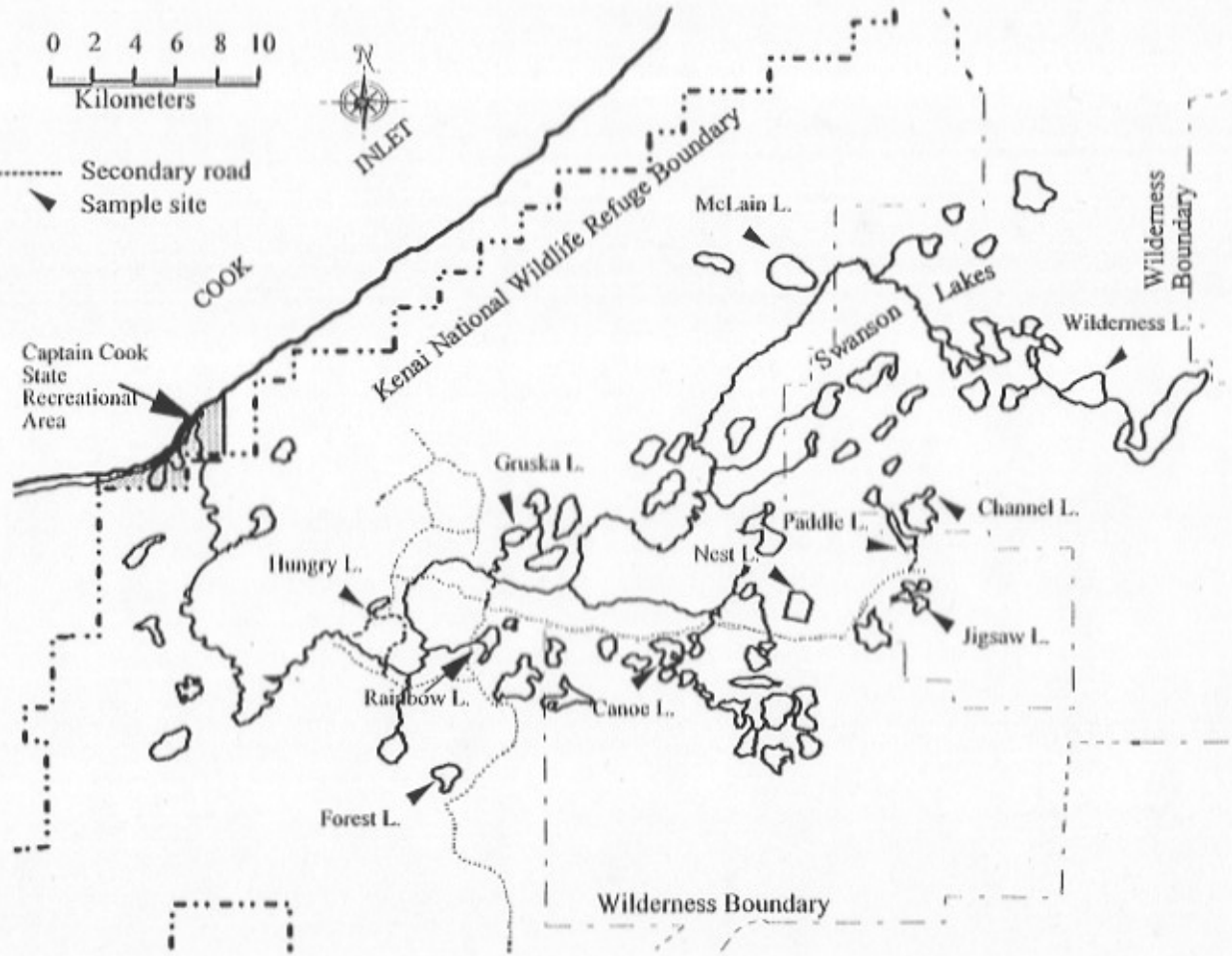

FIGURE 3.–Map of major features and and sampled headwater lakes in the Swanson River drainage, Kenai National Wildlife Refuge, Alaska, 1988-1989.

fine mesh gill net was 15 m long, 1.8 m deep and had four panels of 9 mm, 13 mm, 19 mm and 25 mm stretched mesh. Minnow traps were set in three lakes in 1989.

All fish collected were identified and counted. Rainbow trout were measured to the nearest mm fork length (FL), weighed (g) and gonads were examined to determine sex. Scales were mounted between glass slides and examined using a microfiche reader to determine age (Summerfelt and Hall 1987). CPUE was calculated by dividing the number of each species caught by the number of hours nets were fished, seine hauls made, or minnow traps fished and was used as an index of relative abundance to compare among lakes.

Rainbow Trout

Migration timing.—The timing and duration of adult and juvenile rainbow trout migration between Sucker Creek drainage (Figure 2) and the Swanson River were examined in 1989 by counting the numbers of rainbow trout migrating upstream and downstream on a daily basis. This area was selected because it was easily accessible and supports a rainbow trout population. Rainbow trout were collected using two fyke nets (1.0 m in diameter, 2.7 m long, with two 2.7 m wings and 5 mm mesh). One net was placed facing upstream to sample downstream migrants and one was placed facing downstream to sample upstream migrants. The cod ends were attached to a holding box located between the nets. The box was divided to keep upstream and downstream migrants separated.

From 26 April to 16 June, both traps were fished three to five days each week and checked every 24 hours. The downstream migrant trap was removed 16 June. From 16 June to 17 August, the upstream migrant trap was fished two to three days each week and checked every 24 hours. Trap operation was suspended from 18 August to 27 September due to personnel constraints. Trap operation was restarted on 28 September and continued until 31 October.

Rainbow trout were tagged to make them more visible during spawning ground surveys and to determine rainbow trout migration distances. From 26 April to 30 May, rainbow trout were anesthetized and then measured. Rainbow trout $\geq$250 mm FL were tagged with Floy anchor tags and the first 30 rainbow trout <250 mm FL were tagged with Floy fingerling tags. Upstream migrants were released upstream and downstream migrants were released downstream of the trapping site. After 30 May, fish were not measured or tagged because of time and personnel constraints. Only the total number of fish captured each day was recorded.

Spawning distribution.—Rainbow trout spawning areas in the Swanson River watershed were identified by ground surveys of the mainstem river and outlet streams of lakes known to support rainbow trout populations. Surveys were conducted from mid-May to early June in 1988 and 1989. The mainstem surveys were conducted by canoe from McLain Lake to the weir site in Captain Cook State Park (Figure 2). The outlet streams of Gene, Sucker, Mink, McLain, Salmo, Rainbow and Stormy lakes were surveyed by walking the streams from the lake outlet to the Swanson River. Areas where active redd digging and spawning rainbow trout were observed were recorded on U.S. Geological Survey maps (1:63,360) of the area.

Characterization of length, weight-length relationships.—Length frequency distributions were constructed for riverine and lake populations using 2 mm length intervals. For the river populations, only data collected during the initial effort of the mark and recapture experiment in 1988 and the river survey in 1989 were used.

Mean lengths and weights were calculated by age for each population. A weight-length relationship was developed for each population using the allometric growth model where a and b are constants derived from regressing the logarithms (base 10) of weight (W) and fork length (L)(Andersen and Gutreuter 1983). Functional regressions and intercepts were estimated using the geometric mean regression technique (Ricker 1975). Data from all the lakes having rainbow trout were used except Hungry Lake. For the river population, the data collected during the initial effort of the mark and recapture experiment in 1988 were used.

Results

Relative Abundance

Swanson River.—Seven species of fish were collected in the Swanson River in 1988 including: rainbow trout, threespine stickleback *Gasterosteus aculeatus*, ninespine stickleback *Pungitius pungitius*, slimy sculpin *Cottus cognatus*, juvenile coho *O. kisutch* and sockeye *O. nerka* salmon and Arctic lamprey *Lampetra japonica*. Overall, threespine stickleback was the species most frequently collected (Table 1). In 1989, additional resident species captured were: Dolly Varden *Salvelinus malma* and longnose sucker *Catostomus catostomus* (Table 2).

Overall, rainbow trout and slimy sculpin were the species with the highest percentage of the total catch, representing 39 and 37%, respectively (Table 2). Rainbow trout were more abundant in the upper reaches of the river while slimy sculpin were the most frequently caught in the lower reaches. Both species were captured throughout the mainstem. Although not as abundant, longnose sucker and threespine stickleback were also captured throughout the mainstem. Station four had the lowest catches of all stations.

Headwater lakes.—Species collected in headwater lakes were: rainbow trout, longnose sucker, slimy sculpin, threespine stickleback, Arctic char *S. alpinus*, coastrange sculpin *C. aleuticus*, juvenile coho and sockeye salmon and Arctic lamprey. Rainbow trout and longnose sucker were the species most frequently collected with experimental gill nets (Table 3). Jigsaw Lake was the only lake where gill nets failed to catch fish. Arctic char catch was low, except in Channel Lake. Gruska, Nest, Hungry and Wilderness lakes had the highest catch per unit of effort for rainbow trout. Threespine stickleback was the species most frequently collected with the fine mesh gill net (Table 4). Threespine stickleback was the species most frequently collected in minnow traps and beach seines (Table 5).

TABLE 1.— Fish species collected in the upper reaches of the Swanson River, Alaska, 1988.

Sample site	Gear type	Species
1, 2, 4	Minnow trap	Threespine stickleback
1, , 4		Rainbow trout
1, , 4		Coho salmon[a]
1, , 4		Ninespine stickleback
, 2,		Slimy sculpin
, 4		Arctic lamprey
1, 2, 4	Seine	Threespine stickleback
1, 2, 4		Rainbow trout
1, 2, 4		Coho salmon[a]
1, , 4		Slimy sculpin
, 2, 4		Ninespine stickleback
, 2, 4		Sockeye salmon[b]
1, ,	Electrofishing	Rainbow trout

[a] Juveniles
[b] Adult

TABLE 2.—Catch of rainbow trout, Dolly Varden, juvenile coho and sockeye salmon, slimy sculpin, longnose sucker, threespine stickleback and Arctic lamprey collected with electrofishing gear in the mainstem Swanson River, Alaska, 1989.

Sample Location	Effort (Hrs)	Rainbow Trout	Dolly Varden	Juvenile Coho	Juvenile Sockeye	Slimy Sculpin	Longnose Sucker	Threespine Stickleback	Arctic Lamprey
1	0.50	82	0	0	0	2	2	0	0
2	0.30	30	0	0	0	7	0	7	0
3	0.35	46	0	3	0	3	3	11	0
4	0.35	0	0	0	0	6	3	0	0
5	0.53	72	4	6	0	55	11	28	0
6	0.41	15	0	7	0	15	2	5	5
7	0.56	13	0	2	0	7	27	9	0
8	0.34	21	0	0	0	85	12	9	0
9	0.42	12	0	0	2	93	5	14	0
Total	-	-	4	18	2	273	65	83	5

TABLE 3.—Catch per unit of effort (number/hour) of rainbow trout, juvenile coho salmon, sockeye salmon, Arctic char and longnose sucker collected with experimental gill nets in headwater lakes of the Swanson River watershed, Alaska, 1988-1989.

Lake	Number of Nets	Total Effort (Hours)	Species				
			Rainbow Trout	Juvenile Coho	Sockeye Salmon	Arctic Char	Longnose Sucker
Canoe	4	94	0.4	0.1	0	0	0.1
McLain	5	90	0.6	0	0	0	0.5
Paddle	3	72	0.2	0	0	0	0.3
West Forest	4	88	0.6	0	0	0	0
Wilderness	4	68	1.6	0	0.2	0	0.1
Rainbow	6	144	0.3	0	0	0	0
Gruska	4	80	2.6	0.1	0	0	0.3
Hungry	4	96	1.2	0	0.1	0	0
Jigsaw	4	92	0	0	0	0	0
Channel	4	92	0	0	0	0.7	0
Nest	2	44	2.2	0	0	0	1.1

TABLE 4.—Catch per unit of effort (number/hour) of rainbow trout, juvenile coho salmon, sockeye salmon, slimy sculpin, coastrange sculpin, longnose sucker and threespine stickleback collected with a fine mesh gill net in headwater lakes of the Swanson River watershed, Alaska, 1988.

Lake	Total Effort (Hours)	Species						
		Rainbow Trout	Juvenile Coho	Sockeye Salmon	Slimy Sculpin	Coastrange Sculpin	Longnose Sucker	Threespine Stickleback
Canoe	24	0.2	0.3	0	0	0	0	17.5
McLain	19	0.4	0	0	0	0.2	0.1	12.6
Paddle	24	0	0	0	0.1	0	0	11.7
Rainbow	24	0.1	0	0	0	0	0	8.5
West Forest	22	0.1	0	0	0.1	0	0	0.2
Wilderness	17	0.5	0.2	0.2	0	0	0	1.5

TABLE 5.—Relative numbers (number/haul or trap) of rainbow trout, juvenile coho salmon, slimy sculpin, coastrange sculpin, longnose sucker and threespine stickleback collected with beach seines (BS) and minnow traps (MT) in headwater lakes of the Swanson River watershed, Alaska, 1988-1989.

	Effort		Species											
	Seine Haul	Minnow Trap	Rainbow Trout		Juvenile Coho		Slimy Sculpin		Coastrange Sculpin		Longnose Sucker		Threespine Stickleback	
Lake			BS	MT	BS	MT	BS	MT	BS	MT	BS	MT	BS	MT
Canoe	3	0	0	-	2.3	-	0	-	0	-	0.3	-	5.6	0
McLain	3	0	0	-	2.3	-	0	-	2.6	-	0	-	34.3	-
Paddle	3	0	0	-	0	-	0	-	0	-	0	-	10.6	-
West Forest	3	0	0	-	0	-	0	-	0	-	0	-	16.6	-
Wilderness	1	0	0	-	0	-	0	-	18.0	-	0	-	40.0	-
Rainbow	3	0	0	-	0	-	0	-	0	-	0	-	104.5	-
Gruska	3	0	0	-	0	-	0	-	0	-	0	-	12.6	-
Hungry	2	0	0	-	0	-	0	-	0	-	0	-	55.0	-
Jigsaw	1	6	0	0	0	0	0	0	0	0	0	0	3.0	55.3
Channel	0	6	-	0	-	0	-	25.1	-	0	-	0	-	10.3
Nest	0	5	-	0.2	-	0	-	43.0	-	0	-	0	-	35.2

Rainbow Trout

Migration patterns.—Rainbow trout were collected and measured in both traps from 27 April to 30 May, 1989. After 30 May, only the number of fish were data recorded. Total numbers of rainbow trout collected each day increased rapidly the first three weeks, peaked around 24 May and decreased steadily through 25 June (Figure 4). Small numbers of rainbow trout were captured during October.

Rainbow trout were collected in the upstream migrant trap from 26 April to 30 May, 1989. Total numbers of fish captured each day increased rapidly the first two weeks, peaked around 11 May, then steadily decreased over the next four weeks (Figure 4). Larger rainbow trout (≥ 250 mm) numbers for the downstream migrant trap peaked during the second week in May. Larger rainbow trout started appearing in the upstream migrant trap during the second week in May and numbers were steadily increasing when length measuring was discontinued (Figure 5).

A total of 902 adult rainbow trout (≥ 250 mm FL) were captured and tagged in the downstream migrant trap and 52 (6%) of those were recaptured in the upstream migrant trap. An average of 23 days elapsed between tagging and recapture. Tags from both small and large rainbow trout were returned by anglers from lakes and streams other than Sucker Creek and Sucker Lake.

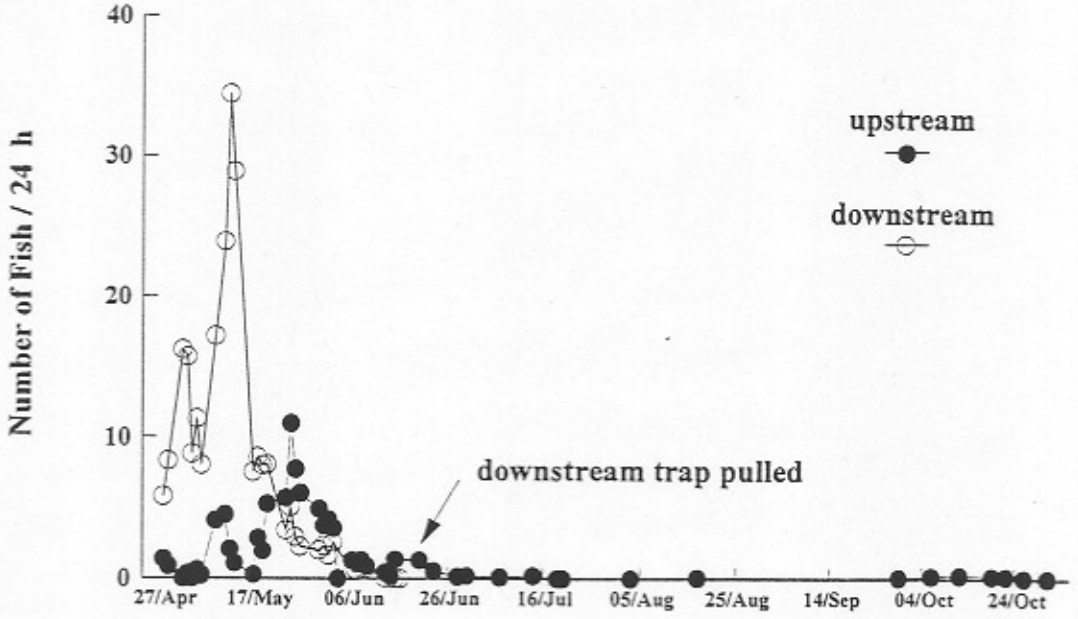

FIGURE 4.—Total numbers of rainbow trout captured in the downstream migrant trap and the upstream migrant trap at Sucker Creek, Kenai National Wildlife Refuge, Alaska, 26 April - 31 October, 1989.

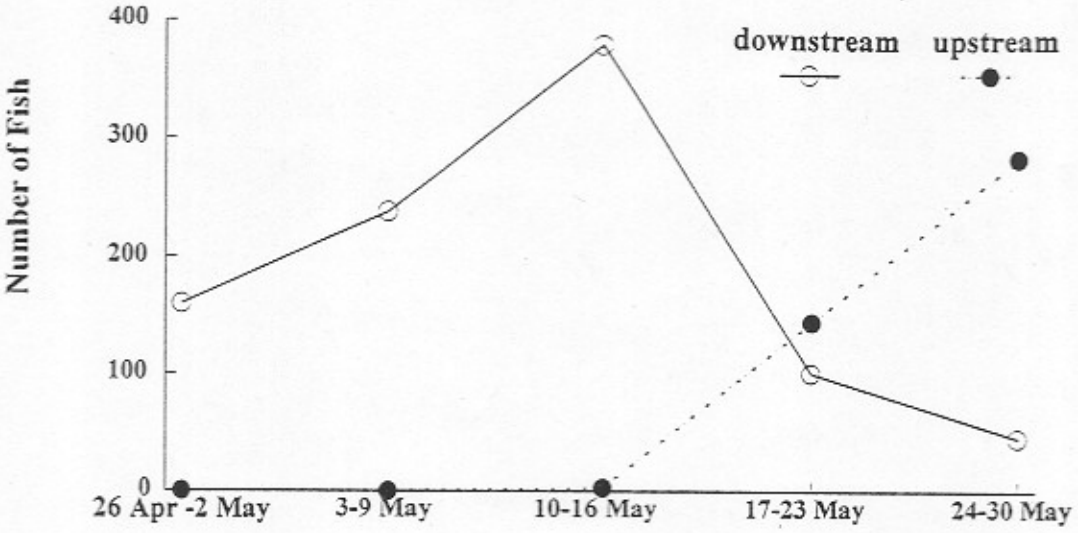

FIGURE 5.—Number of larger rainbow trout (≥ 250 mm) captured in the downstream migrant trap and the upstream migrant trap at Sucker Creek, Kenai National Wildlife Refuge, Alaska, 26 April - 30 May, 1989.

Spawning distribution.—One area was observed where rainbow trout were actively spawning in the upper reaches of the mainstem Swanson River (Figure 6). Forty to fifty rainbow trout and about 15 redds were estimated in this section. Rainbow trout were observed spawning throughout the lower reaches of the mainstem (Figure 6). Spawning activity was concentrated at the upper and lower oil field bridges, the mouth of Crane Lake Creek and the weir site. Rainbow trout tagged in Sucker Creek during 1989 were observed throughout the river from the canoe landing to the weir site and one was observed in Stormy Lake Creek.

Sucker Creek was the only tributary stream where large numbers of rainbow trout redds were observed (59). Several redds were observed in Gene Lake Creek and at the outlet of Stormy Lake, but these areas had very little spawning gravel.

Characterization of length, weight-length relationships.—Rainbow trout in headwater lakes ranged from 86 to 498 mm FL with lengths between 240 and 320 being the most frequent (Figure 7). Very few rainbow trout smaller than 200 mm FL were collected. In contrast, rainbow trout in the river ranged from 50 to 291 mm FL with lengths between 80 and 120 mm the most frequent (Figure 7). Ninety-one percent of the total catch in the river was less than 200 mm FL.

Rainbow trout in the river were primarily age 1 and 2, while ages 4 and 5 were dominant in most of the rainbow trout lake populations. Canoe, Wilderness and Gruska lakes had large percentages of ages 3, 4 and 5. Mean length and mean weight for each age group, are listed for the lakes and river in Table 6. Age 1 and 2 rainbow trout were collected in several lakes but sample sizes were low. Except for Wilderness and Hungry lakes, males and females were not significantly different ($P>0.05$).

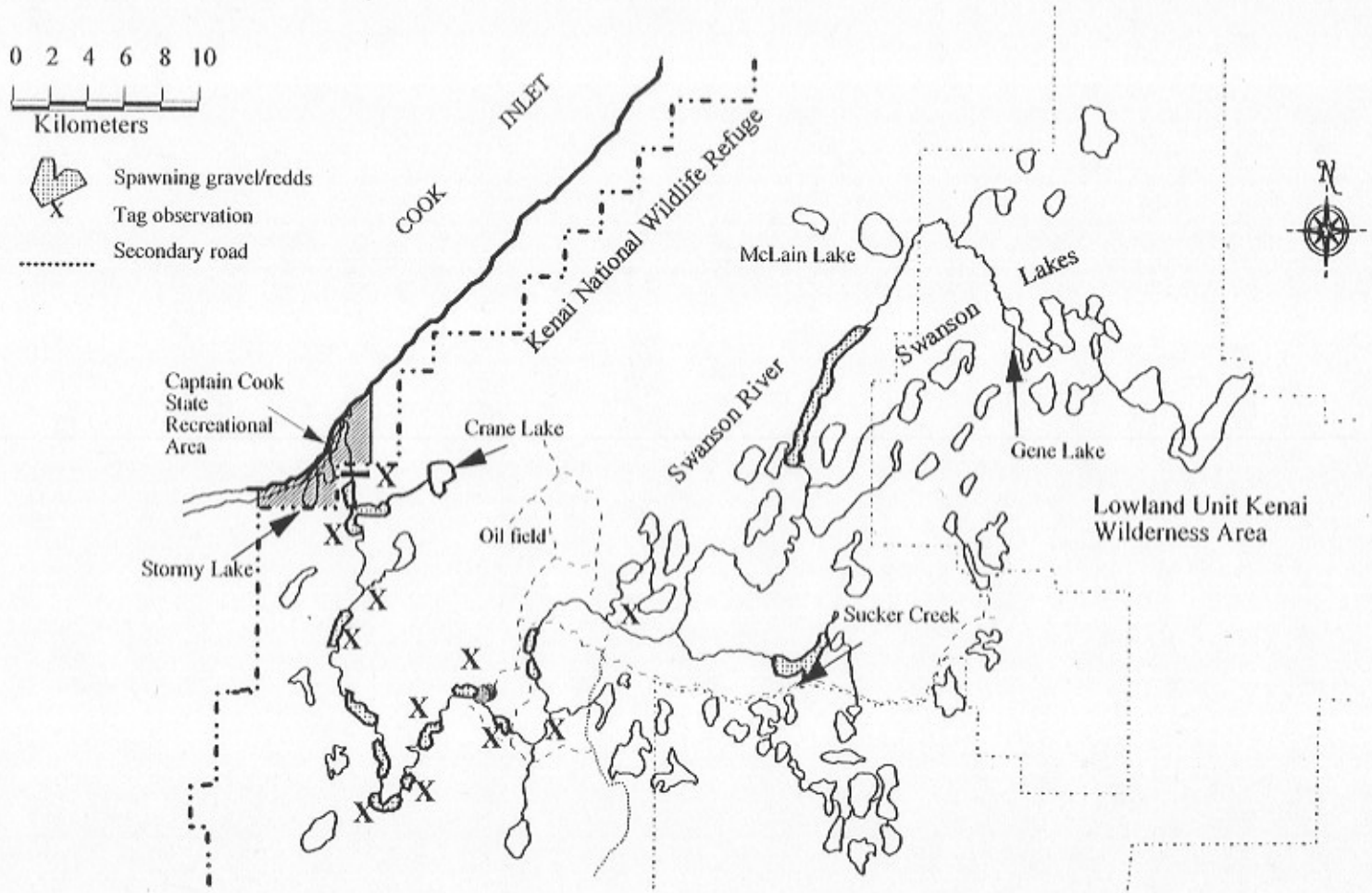

FIGURE 6.–Rainbow trout spawning habitat as determined from ground surveys in the Swanson River watershed, Kenai National Wildlife Refuge, Alaska, 1989.

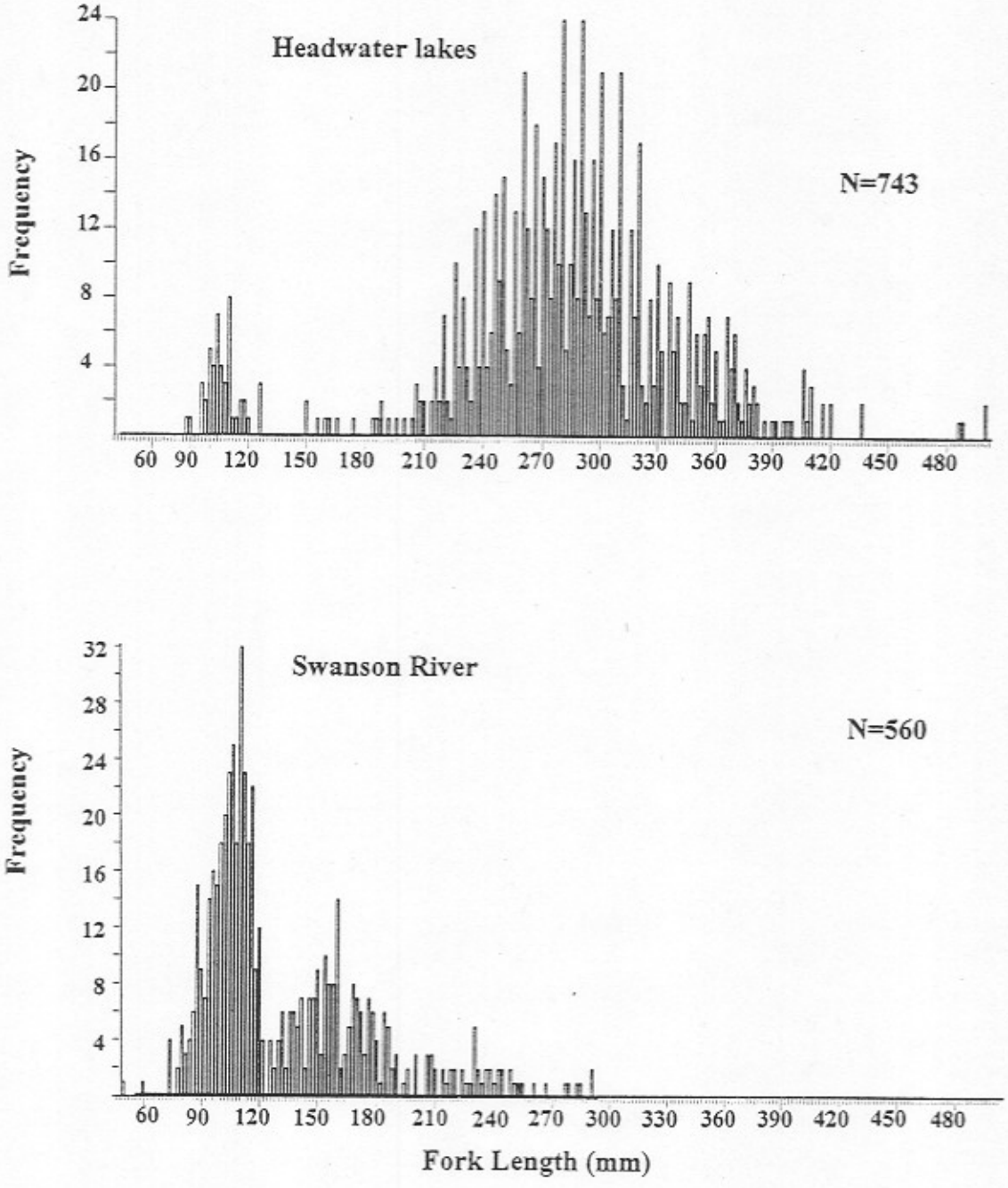

FIGURE 7.—Length frequency distributions of rainbow trout collected from headwater lakes and the Swanson River, Alaska, 1988-1989.

TABLE 6.—Number, percent (%), mean length and mean weight for each age group of rainbow trout collected from the Swanson River watershed, Alaska, 1988-1989.

Date	Lake	Age	*N*	%	Length (mm)		Weight (g)	
					Mean	SE	Mean	SE
6/30/88	Rainbow	2	2	5.2	143	18	35	9
		3	7	17.9	299	11	286	29
		4	14	35.9	344	14	437	35
		5	16	41.0	373	14	593	60
7/13/88	McLain	1	2	3.3	92	5	9	1
		2	5	8.4	123	10	23	7
		3	4	6.6	258	22	214	53
		4	20	33.3	293	8	280	21
		5	24	40.0	296	8	311	21
		6	5	8.4	324	9	367	47
7/20/88	West Forest	3	1	2.2	310	-	396	-
		4	25	55.6	294	8	305	28
		5	13	31.1	343	14	465	54
		6	3	8.9	372	20	612	191
		7	1	2.2	500	-	1,550	-
8/11/88	Canoe	2	1	2.3	174	-	58	-
		3	13	30.3	245	10	179	19
		4	13	30.3	294	10	315	36
		5	10	23.2	351	11	514	45
		6	5	11.6	362	14	594	68
		7	1	2.3	370	-	694	-
8/17/88	Paddle	3	2	18.2	250	15	191	41
		4	6	54.5	281	8	252	20
		5	3	27.3	358	18	515	84
9/14/88	Wilderness	3	38	33.6	238	5	148	9
		4	51	45.2	273	4	219	9
		5	21	18.6	295	7	268	19
		6	3	2.6	305	5	293	18

Table 6.—(Continued).

Date	Lake	Age	*N*	%	Length (mm) Mean	Length (mm) SE	Weight (g) Mean	Weight (g) SE
6/27/89	Hungry	1	4	5.6	104	2	N/A	
		2	3	4.2	105	1	N/A	
		3	7	9.7	248	13	N/A	
		4	23	31.9	263	6	N/A	
		5	27	37.5	286	5	N/A	
		6	7	9.7	292	7	N/A	
		8	1	1.4	332	-	N/A	
6/29/89	Gruska	1	21	14.3	102	2	13	1
		2	10	6.8	113	4	18	3
		3	37	25.2	252	1	167	8
		4	43	29.3	270	5	213	11
		5	27	18.4	309	6	304	19
		6	7	4.8	340	12	365	25
		7	2	1.4	373	33	645	245
9/29/89	Nest	3	10	11.2	258	9	216	22
		4	29	32.6	282	7	270	19
		5	34	38.2	323	7	443	26
		6	11	12.4	346	6	525	26
		7	4	4.5	353	20	611	94
		8	1	1.1	397	-	725	-
Swanson River		1	59	39	108	2	13	1
		2	57	38	158	3	42	2
		3	17	11	209	6	96	11
		4	18	12	243	7	151	13
		5	1	1	291		218	

N/A = Information not available

Discussion

Relative Abundance

Swanson River.—Resident fish populations in the mainstem Swanson River were not previously sampled. Thus, our data represents the baseline for future comparative studies or evaluations.

Future sampling will require careful selection of sampling methods, since no single method provides unbiased results. Minnow traps and seines were effective in capturing smaller fish (<120 mm FL), primarily threespine stickleback. Very few sculpin were captured using these methods. Because of extensive aquatic vegetation, seining was ineffective. The D.C. pulse electrofishing equipment was more efficient in capturing a wider size range of fish, especially larger rainbow trout, adult longnose suckers and sculpin. The use of electrofishing gear for estimating the relative abundance of smaller fish species, such as sculpin and stickleback, is probably biased since smaller fish are less susceptible to electrical current than larger fish (Sullivan 1956; Reynolds 1983). Although the 1989 data indicate rainbow trout are more abundant than sculpin or stickleback, it is reasonable to expect that the opposite is true because of sampling gear bias toward larger fish.

Headwater lakes.—Because of differences in sampling gear, sampling locations and sampling dates, comparison of historical and recent data is relatively awkward. Sculpin and stickleback were infrequently captured in historical surveys but the investigators did not use minnow traps (Appendix 1).

Gear and thus effort for sampling rainbow trout varied widely over time in most of the lakes we examined (Appendix 2). So it was not possible to determine whether variations in catch per unit of effort are attributable to population changes or sampling efforts. Future sampling should use comparable methods of collection.

Rainbow Trout

Migration patterns.—The purpose of examining migration patterns was to investigate the theory that larger rainbow trout are primarily lake residents and use the mainstem for spawning while juvenile rainbow trout reside in the river, 1-3 years, before migrating into lakes for rearing. Data from this survey suggests that adult rainbow trout which migrate down from Sucker Lake do not spend long periods of time out of the lake (Figure 4). Yet, fidelity to a specific lake is questioned because of the tag returns from outside the Sucker Creek drainage.

There appears to be a substantial migration of younger aged rainbow trout (age 1-4) upstream into Sucker Lake. Whether these younger rainbow trout were rearing in the creek or in the mainstem of the Swanson River was not determined.

Spawning distribution.—The upper and lower oil field bridges and the lower reaches of the Swanson River just upstream from Captain Cook State Recreation Area (rkm 2.6 - 4.8) were originally believed to be the only areas in the Swanson River where rainbow trout were spawning

(Elliott 1988). However, no previous spawning surveys were conducted to confirm the spawning distribution of rainbow trout in the Swanson River. Our surveys revealed that rainbow trout are spawning throughout the upper and lower reaches of Swanson River and in Sucker Creek where suitable gravel is available. Based on data collected in 1974-1976 (Elliot 1988) and our data from tagged fish in Sucker Creek, rainbow trout in the Swanson River migrate extensively throughout the system for spawning and/or feeding.

Characterization of length, weight-length relationships.—Generally, rainbow trout populations do not appear to have changed much in any of the lakes we examined. Mean lengths and mean weights do not show any dramatic changes over time (Appendix 3). When comparing mean-length-at-age to Upper Kenai Peninsula rainbow trout sampled by hook-and-line in 1995, Swanson River rainbow trout are smaller (McCarron 1996). This is expected because the Swanson River lacks glacial lakes and the extremely large salmon runs which would increase productivity and available forage.

Recommendations

Relative species composition has remained the same over time. Fishing pressure, in terms of angler days, has increased since 1988 and harvest of rainbow trout has been fairly consistent. Multiple causes exist for this increase in fishing pressure, two of them are: 1) the whole Kenai area has risen in popularity since the early 1980s; and, 2) since 1988-89, public awareness of the Swanson River coho salmon run has attracted more anglers. From a management position these changes have not yet caused a public concern (Nelson 1995).

Monitoring resident species population size, distribution and composition, every 5-10 years is recommended. This survey's baseline data with future monitoring programs and creel information will allow managers to determine if changes are occurring due to increased angling pressure.

Available spawning habitat may be more extensive than previously suggested. A study focusing on habitat and spawning density of rainbow trout may benefit managers who are monitoring rainbow trout populations in the Swanson River watershed.

Future sampling should be standardized and include seining, minnow traps, gillnets and hook-and-line. The first three methods were used in the study and hook-and-line is the standard method for rainbow trout sampling in southcentral Alaska. Priority efforts should be on the Swanson River since most of the increase in fishing pressure is in the mainstem. Use and angling efforts on the canoe routes have remained relatively stable (Johnston, *personal communication,* 1996).

Acknowledgments

We express our appreciation to all those people who contributed to this project: co-workers Mary Faurot, Gerry Gray, Jim Lazar and Ted Otis; Student Conservation Volunteers Ken Bosse, Dana Bruden, Sym Colovos, Dan Epstein, Rick Hurst, Vincent Lofaro, Michelle Link, Jeff Melegari, Art Schaub, John Tobin and Shannon Winters; U.S. Fish and Wildlife Service volunteers Jack Dean, Bob Harned, Todd Mabee, Bob Murray, R.D. Nelle and Rob Steinmetz; Kenai National Wildlife Refuge pilots Bill Larned and Rick Johnston; and our office secretary Anne Barrett who originally typed this manuscript.

We also appreciate support and cooperation of the Alaska Department of Natural Resources, Division of Parks and Outdoor Recreation.

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APPENDIX 1.—Historical record of fish species (rainbow trout=RB, coho salmon=SS, sockeye salmon=RS, Dolly Varden/Arctic char=DV/AC, longnose sucker=LS, sculpin=CD, threespine stickleback=SB) collected in various Swanson River headwater lakes, Alaska.

Lake	Year	Gear	Species						
			RB	SS	RS	DV/AC	LS	CD	SB
Canoe	1964[a]	Gillnet	X	X	X	X	X		
	1974[b]	Gillnet	X				X		
	1984[b]	Gillnet & Minnow Trap	X	X	X	X	X	X	X
	1988	Gillnet & Seine	X	X		X	X		X
Channel	1965[a]	Gillnet	X			X	X		X
	1989	Gillnet & Minnow Trap	X			X	X	X	X
Gruska	1963[a]	Gillnet	X				X		
	1974[b]	Gillnet	X	X			X		
	1989	Gillnet & Seine	X	X			X	X	X
Hungry	1963[a]	Gillnet	X						
	1985[b]	Gillnet	X						
	1989	Gillnet & Seine	X	X			X		X
McLain	1984	Gillnet & Minnow Trap	X	X	X		X	X	X
	1988	Gillnet & Seine	X	X			X	X	X
Nest	1971[a]	Gillnet	X				X		
	1975[b]	Gillnet	X						
	1989	Gillnet & Minnow Trap	X	X			X	X	X
Paddle	1965[a]	Gillnet	X	X		X	X		
	1983[b]	Gillnet	X			X	X	X	X
	1988	Gillnet & Seine	X			X	X	X	X
Rainbow	1960[a]	Gillnet	X						
	1964[a]	Gillnet	X						
	1972[a]	Gillnet	X						
	1974[b]	Gillnet	X						

APPENDIX 1.—(Continued).

Lake	Year	Gear	Species						
			RB	SS	RS	DV/AC	LS	CD	SB
Rainbow	1984[b]	Gillnet & Minnow Trap	X					X	X
	1988	Gillnet & Seine	X						X
West Forest	1963[a]	Gillnet	X						
	1975[b]	Gillnet	X						
	1984[b]	Gillnet & Minnow trap	X	X				X	X
	1988	Gillnet & Seine	X					X	X
Wilderness	1971[a]	Gillnet	X			X	X		
	1984[b]	Gillnet & Minnow Trap	X		X	X	X		
	1988	Gillnet & Seine	X	X	X		X	X	X

[a] Data source: Alaska Department of Fish and Game, Soldotna, Alaska.
[b] Data source: U.S. Fish and Wildlife Service, Kenai, Alaska.

APPENDIX 2.—Comparison of historical (pre-1988) and current catch data for rainbow trout collected with experimental gill nets in various Swanson River headwater lakes, Alaska.

Lake	Year	*N*	Effort (hours)	Catch per unit effort
Canoe	1964[a]	37	47	0.79
	1974[b]	47	42	1.11
	1984[b]	15	56	0.27
	1988	41	94	0.43
Channel	1965[a]	22	46	0.48
	1989	2	92	0.02
Gruska	1963[a]	49	31	1.58
	1974[b]	69	19	3.60
	1989	205	80	2.56
Hungry	1963[a]	59	81	0.73
	1985[b]	25	22	1.13
	1989	114	96	1.19
Mclain	1984[b]	92	84	1.10
	1988	53	90	0.59
Nest	1971[a]	26	41	0.63
	1975[b]	14	1	14.00
	1989	97	44	2.20
Paddle	1965[a]	35	120	0.29
	1983[b]	52	104	0.50
	1988	11	72	0.15
Rainbow	1960[a]	28	202	0.14
	1974[b]	1	46	0.02
	1984[b]	38	84	0.45
	1988	40	144	0.28
West Forest	1963[a]	24	53	0.45
	1975[b]	19	42	0.45
	1984[b]	27	84	0.32
	1988	52	88	0.59
Wilderness	1971[a]	1	33	0.03
	1984[b]	71	78	0.91
	1988	117	82	1.42

[a] Data source: Alaska Department of Fish and Game, Soldotna, Alaska.
[b] Data source: U.S. Fish and Wildlife Service, Kenai, Alaska.

Appendix 3.-Comparison of historical and current mean lengths and mean weights of rainbow trout collected from nine headwater lakes in the Swanson River watershed, Alaska.

Lake	Year	n	Mean Length (mm)	Mean Weight (g)
Canoe	1984	15	313	316
	1988	43	299	354
McLain	1984	50	273	230
	1988	62	272	261
Rainbow	1984	33	313	396
	1988	39	337	453
Paddle	1983	48	302	350
	1988	12	303	342
Forest	1984	26	321	413
	1988	50	314	388
Wilderness	1984	65	288	269
	1988	117	266	206
Gruska	1976	68	267	252
	1989	199	247	189
Hungry	1985	25	328	.
	1989	20	278	.
Nest	1975	14	339	449
	1989	97	308	381

Data source: U.S.Fish and Wildlife Service, Kenai, Alaska.